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the Ray Society in 1869. The older work has become naturally very incomplete, for during the last 50 years there has been an enormous increase in the knowledge of abnormal structures. The work will comprise two volumes, the first one containing the fungi, the bryophytes, and the root, stem, and leaf of the vascular plants. The algae are not included because they exhibit too few abnormalities to make description worth while. The second volume will deal with the flower. This bringing together of the great mass of material in convenient form will be a boon to those interested in teratology.—J. M. C.

Western wild flowers.—MARGARET ARMSTRONG,[3] in collaboration with J. J. THORNBER, has written a handy and well illustrated volume under this title, which, although primarily intended for lovers of wild flowers, will be useful to botanists as well. The wild flowers of Washington, Oregon, California, Idaho, Utah, and Arizona are dealt with, but those found only in the Rocky Mountains are not included. The key to families is an excellent feature, and the usefulness of the volume would be much greater had it been extended to species. The collaboration of Professor THORNBER insures the accuracy of the text.—W. J. G. LAND.

NOTES FOR STUDENTS

Transpiration studies.—The desirability of giving a quantitative turn to ecological description and classification, together with the recognition that the most useful of such classifications have been based upon the water relations, has led to efforts to measure the power of the plant (1) to absorb water from its surroundings, (2) to distribute this water within its body, and (3) to prevent the loss of water to its environment. To study the third feature of the water relation some means of measuring the resistance offered by leaves and other parts of plants to water loss, or, stated in other words, of measuring the relative transpiring power of plants, has been needed. A further requirement of such a system is that it shall be readily applicable to plants growing in open soil. In seeking to meet this need LIVINGSTON[4] has modified the cobalt paper method of STAHL, and adapted it to compare the transpiring power of a leaf with evaporation from a standard surface, namely, that of saturated blotting paper shown by RENNER to evaporate water at the same rate as an equal area of free water surface. In a series of experiments he has shown that this new method is probably the most satisfactory known for comparing the same plant at different times, or for comparing different plants, in regard to the transpiring power of their surfaces. The ratio of the time required for color change of the standardized cobalt chloride paper exposed over the standard surface, to the corresponding time required for the same change when the paper is applied to the plant surface, he has termed the "index of transpiring power."

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[3] ARMSTRONG, MARGARET, Field book of western wild flowers. 16mo. pp. xx+396. *figs. 548.* New York: Putnam. 1915.

[4] LIVINGSTON, B. E., The resistance offered by leaves to transpirational water loss. Plant World **16**:1–35. 1913.

BAKKE,[5] in making use of this method, has shown that the experimental error incurred in determining the time of color change is not large, and further that it may be possible so to standardize the hygrometric paper that the constant use of the standard surface may be dispensed with by making a correction of a given time coefficient according to air temperature. In his own experiments, however, he continues to use the standard surface. Testing the leaves of 43 different species growing under irrigated conditions at the University of Arizona, indices were obtained ranging from 0.9288 for *Dahlia variabilis*, 0.8473 for *Verbena hybrida*, and 0.7893 for *Medicago sativa*, to 0.2258 for *Olea europea*, 0.1676 for *Nerium oleander*, 0.0603 for *Chenopodium incanum*, and 0.0025 for *Atriplex elegans*. These data would seem to afford a most satisfactory basis for ecological classification, and he makes the tentative proposition of including under mesophytes plants with diurnal foliar indices of transpiring power above 0.70, and of terming xerophytes all with indices below 0.30, with the possibility of an intermediate critical point at the index 0.50; the desirability and designation of the groups thus formed to be determined by further study. BAKKE also shows that the method may well be applied to the determination of the daily march of foliar transpiring power, and gives some data upon the relation of position upon the plant and age of leaves to their transpiring power, making his paper a good example of the use of this new technique in its possible application to various problems.

More recently, in studying the vegetation of the Santa Catalina Mountains, SHREVE[6] has measured the transpiring power of some 20 species and has found that (1) while the indices of the transpiring power are similar within various groups of life forms, they are not so to the extent that they may be predicted from an examination of the foliage of the plant; (2) the indicas ere higher in plants which grow in flood plains with good moisture supply than in individuals of the same species upon arid slopes; and (3) the transpiring power of a given species is not unlike at different altitudes, but the maximum value for the day is reached at an earlier hour at lower than at higher elevations, while for some species at some 6000 feet, no check in the rate is manifested, and the maximum transpiring power and maximum evaporation are simultaneous.

Some of these results were to be expected from the former results of Mrs. SHREVE,[7] obtained in a very exact study of the actual amount of water lost by the desert shrub *Parkinsonia microphylla*, using both potted plants and branches on larger individuals growing in the open passed into a closed chamber under a bell glass, where the amount of water given off by the plant was found from the gain in weight of calcium chloride exposed within the chamber. Her method of work, as described, seems to provide against any vitiating errors, and clearly demonstrates in this shrub, both when leafless and in leaf, a distinct drop and subsequent rise in actual and relative transpiration (transpiration divided by evaporation) in the morning before the time of maximum evaporation for the day. The maxima for relative transpiration for potted plants were found to vary directly with the soil moisture, and some evidence was obtained that the same variation exists in plants growing naturally in the desert region about Tucson, Arizona. It was also found that *Parkinsonia* plants in sunlight exhibit hourly changes in the relative transpiration rate, in the amount of opening of stomata, in water content of leaves and twigs, and in leaf temperature, and that these have evident interrelations which are held to be governed by the ratio of the demand to the available supply of water.

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[5] BAKKE, A. L., Studies on the transpiring power of plants as indicated by the method of standardized hygrometric paper. Jour. Ecology **2**:145–173. 1914.

[6] SHREVE, F., The transpiring power of plants as influenced by differences of altitude and habitat. Science **43**:363. 1916.

[7] SHREVE, EDITH B., The daily march of transpiration in a desert perennial. Carnegie Inst. Wash. Publ. no. 194. pp. 64. *figs. 27*. 1914.

The transpiration absorption water balance in this woody perennial, as it grows at Tucson, seems to be adjusted with the coming on of the summer drought conditions by (1) the leaflets beginning to close earlier each day, until finally they remain open only for a few minutes at dawn and twilight; (2) the transpiration amount being lessened with the drying out of the soil; (3) the leaflets and later the rachis dropping; and (4) the twigs and small branches beginning to die. In addition to these seasonal changes, there is a daily closing of leaflets and a lessening of actual transpiration rate, while the evaporating power of the air is still increasing. This decrease is accompanied by a closure of stomata, a lowered water content of leaves and twigs, and a slight rise in leaf temperature. The drop is followed by a rise, which, however, does not equal the former maximum. Mrs. SHREVE's investigation of *Parkinsonia* may serve as a model for the study in detail of the transpirational behavior of other similar and dissimilar plants in the accumulation of data necessary for the understanding of the relationship of vegetation to atmospheric and soil moisture. In attempting such studies, the investigators will do well to note her conclusion that relative transpiration rates were found to differ according to the previous environment of the plant, and hence that conclusions regarding the actual transpiration of plants *in situ* cannot be drawn from the measurement of losses from potted plants, but may be learned better from the measurement from small branches of the plant grown in its natural environment.

Among other recent contributions to our knowledge of transpiration is a study by GIDDINGS[8] of some excised leaves of *Silphium laciniatum*, where in a comparatively few experiments a comparison between rates of evaporation and transpiration showed that here also a check in the latter process occurred 1–3 hours before the daily maximum rate of evaporation was reached, somewhere between 1:00 and 3:00 P.M., showing the influence of internal factors upon transpiration. The rate of evaporation was determined by Piche atmometers and transpiration loss by weighing closed bottles of water in which the excised leaves were inserted. Leaves taken from the same plant at heights of 13, 47, 71, and 100 cm. showed relative transpirational losses per unit area of 100, 114, 103, and 86, or a somewhat smaller loss from the upper leaves than from the lower ones placed under the same conditions.

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[8] GIDDINGS, L. A., Transpiration of *Silphium laciniatum*. Plant World **17**:309–328. 1914.

BURNS[9] has compared the transpiration of *Pinus Strobus* seedlings grown in nursery beds unshaded, half shaded, and full shaded, with the evaporation from black and white atmometers, and has found a closer relation between the transpirational losses and those from the black atmometer. The relative transpiration was here for the unshaded, half shaded, and full shaded plants respectively 0.0633, 0.0346, and 0.0088, from which he calculated the amount of water transpired to be proportionately 21, 8, and 1 parts. A further comparison showed the average green weight of the unshaded, half shaded, and full shaded plants to be respectively 0.304, 0.166, and 0.090 gm.; while the dry weight was 0.063, 0.034, and 0.010 gm.; that is, the dry weight of the shadeless plants was 6 times that of the full shaded, and twice that of the half shaded plants. On the other hand, the nitrogen content in percentage of dry weight was respectively 2.18, 2.70, and 6.89, or nearly 3 times as much in the full shaded plants as in either of the others, showing that a large amount of transpiration is not to be related to the absorption of ash constituents. BURNS concludes that his experiment indicates that differences in size and chemical composition of these white pine seedlings must be sought along the line of photosynthesis and assimilation, rather than through absorption and transpiration.—GEO. D. FULLER.

Taxonomic notes.—COTTON[10] has described collections of cryptogams made by Mrs. ELINOR VALLENTIN, in 1909–1911, on the western islands of the Falklands. An interesting account of the phytogeography of the region is followed by systematic lists of marine algae (138 spp.), freshwater algae (54 spp.), lichens (95 spp.), and fungi (36 spp.). The representation of the four groups of algae is as follows: Cyanophyceae, 4 spp.; Chlorophyceae, 26 spp. (one new); Phaeophyceae, 39 spp.; Rhodophyceae, 69 spp. (one new). The list of fungi includes descriptions of 6 new species.

FERNALD and WEATHERBY[11] have investigated the perplexing genus *Puccinella*, a group of species placed by some in *Glyceria* and by others in *Fes-*

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[9] BURNS, G. P., The relative transpiration of white pine seedlings. Plant World **18**:1–6. 1915.

[10] COTTON, A. D., Cryptogams from the Falkland Islands collected by Mrs. VALLENTIN. Jour. Linn. Soc. Bot. **43**:137–231. *pls. 4–10.* 1915.

[11] FERNALD, M. L., and WEATHERBY, C. A., The genus *Puccinellia* in Eastern North America. Rhodora **18**:1–28. *pls. 114–117.* 1916.